Title: The Minnesota Dye Trace Database

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In the karst regions of Minnesota, groundwater tracing using fluorescent dyes has proven to be an effective method for understanding groundwater flow, travel times and interconnections with surface water (streams, creeks, etc). Dye tracing in Southeast (SE) Minnesota has a long history. The first documented traces were performed by S.P. Kingston, a public safety engineer at the Minnesota Department of Health, in the late 1930s. Kingston used fluorescent dye to discover the source of an outbreak of typhoid fever in Fillmore and Olmsted Counties and published his work in the Journal of the American Water Works Association. Additionally, Ron Spong conducted over 30 traces beginning in the 1970s across several counties in SE Minnesota. Most of the dye tracing in Minnesota since that time has been a collaborative effort between the University of Minnesota and the Minnesota Department of Natural Resources but stakeholders such as towns and cities, soil and water conservation districts, the local caving community and generations of students have often been involved as well.

Dye tracing involves using fluorescent dyes to determine groundwater flow direction and velocity by pouring dye into a sinkhole or sinking stream and observing where it emerges (usually at a spring or multiple springs) after flowing through the karst conduit system. Positive sampling results allow scientists to infer approximate groundwater flowpaths, calculate minimum velocities, and begin to delineate springsheds. In general, springsheds are composed of Groundwater Springsheds (GwS), Surface Water Springsheds (SWS) and Regional Groundwater Springsheds (RGS) and understanding their combined extent is important for the protection of trout stream resources and other ecosystems in Minnesota karst areas and elsewhere. Additionally, water protection and management associated with spill response, agriculture, water demands and landscape alteration require effective means for delineating springsheds. Many dye traces and the resulting springshed delineations have been accomplished in SE Minnesota, but the results and reporting have had varying degrees of accessibility.

The goal of the current project is to produce a web accessible database containing as many groundwater dye tracing results as possible. This effort involves mining trace reports, data tables, and field notes and organizing their contents using GIS. The DNR Dye Trace Reports webpage currently has a list of links to historic and recent dye trace reports that are catalogued and made publicly available on the University of Minnesota Digital Conservancy. Geospatial data (dye input points, inferred groundwater flowpaths and springshed delineations) are re-evaluated in some cases, quality checked, and then digitized. Eventually this data will be made available via the DNR webpage in the form of an accessible ArcGIS Online map interface where users can query, select and view the data and associated reports with the click of a button. This database is intended to be used in conjunction with the Minnesota Karst Features Database (Gao, Yongli. (2002) “Karst Feature Distribution in Southeastern Minnesota: Extending GIS-Based Database for Spatial Analysis and Resource Management.”. PhD Thesis, Univ. of Minn., Geology & Geophysics Dept., 210 p.) and will likely be incorporated into an enterprise system of spatially related databases built upon the Karst Feature Database and the Minnesota Spring Inventory.

The Minnesota Dye Trace Database is an important element to manage and protect groundwater in Minnesota. Revitalizing dye tracing data, making the documentation available, and creating a user friendly interface will add context to the knowledge and expansive inventory of karst in Minnesota and will hopefully allow this significant dataset to live in perpetuity for generations of scientists and policy makers to come.